

An Overview Of How Jet Propulsion Laboratory Develops Mission Systems.

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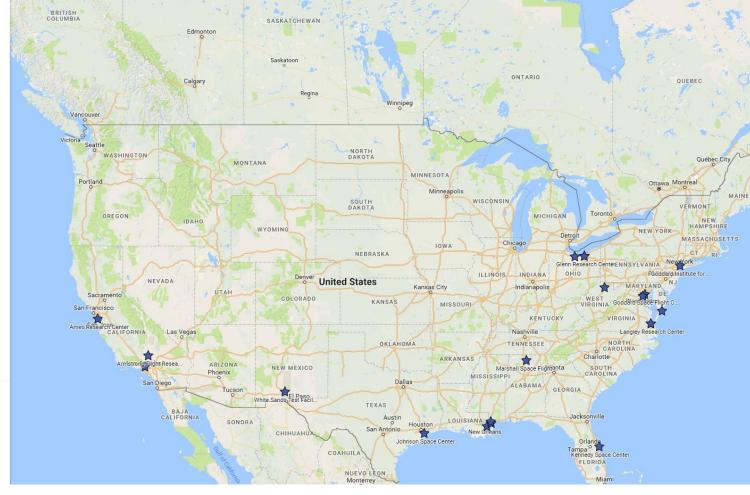
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- WBS Material adopted from NASA Procedural Requirements NPR 7120.5E

NASA Centers and Facilities

There are 10 **NASA** centers, which provide leadership for and execution of **NASA**'s work



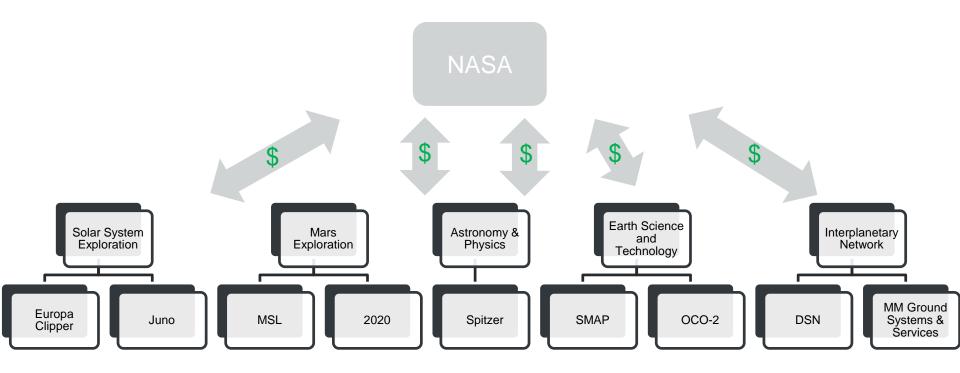


Jet Propulsion Laboratory

JPL is a federally funded research and development center

- The Jet Propulsion Laboratory is a national research facility that carries out robotic space and Earth science missions.
- In addition to its missions, JPL developed and manages NASA's Deep Space Network, a worldwide system of antennas that communicates with interplanetary spacecraft.
- JPL is a federally funded research and development center managed for NASA by Caltech.
 - JPL is very different from most NASA Centers in that it:
 - Develops entire flight system including hardware, software and integration
 - Integration of contractor flight systems
 - Can all be outsources or mixed with in house
 - Management / Oversight
 - Entire mission <-> to single instruments
 - Operations
 - Entire flight system <-> single instruments
- ~5000 employees
 - Engineering & Science, Solar system Exploration, Safety & Mission Success, Mars Exploration, Astronomy & Physics, Earth Science and Technology, Interplanetary Network.

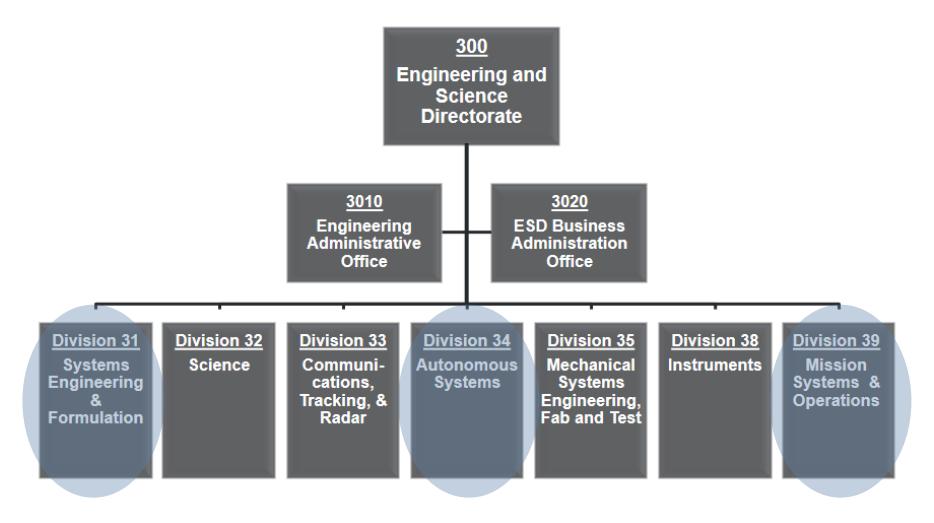
Responsibilities at JPL (Projects/Program)



These directorates are responsible for oversight, development, integration and operations

Note: Projects shown are illustrative of a subset of the JPL mission work

Engineering And Science (Line)



Engineering And Science (Core Capabilities)

ESD

Systems Eng. & Formulation 31
Systems Architecti
Mission Concept Dev. Form Strategy
Systems Modeling
Cost Modeling
Collaborative Eng. Methods
Proposal Production

Project Systems

Engineering Mission Planning

Flight System

Systems Engineering

Payload Systems Eng.

EDL Sys.

Resilient Sys. & Fault Mgmt.

End-to-End Information Systems

Electrical Sys. Eng.

Flight Sys. Integ. & Test Launch Approval Science 32

Planetary Science

Earth Science Astrophysics

Heliophysics

Laboratory Science

Suborbital Measurements

Flight Mission and Instrument Science

Data Analysis

Modeling

Project Science Leadership

Adv. Concepts and Technologies Communications Tracking & Radar 33

Deep Space Communications

Telecom Svs. Ena.

Tracking Systems

Ground Telecom

Flight Telecom

Optical Comm. Radars

Adv. Concepts and Technologies

GPS/GNSS

Autonomous Systems 34

End To End Robotic Excellence

Mobility Systems

C & DH

Power

GNC Eng and S/W Att. Control H/W

Precision Motion Control and Celestial Sensors

Adv. Concepts and **Technologies**

Mechanical Systems Eng., Fab & Test 35

Structures and Mechanisms

Structural Analysis EDL and Mobility Systems

Sampling Systems Opto-mechanical

Thermal Analysis and Hardware

Cryogenic Thermal Systems

Chemical

Materials

Propulsion **Electric Propulsion**

Contamination Control

Planetary Protection

Environ, Test Lab

Electronic and Mechanical Fabrication

Measurement Instrumentation

Adv. Concepts and Technologies

Instruments 38

Instrument Systems Engr.

> Interferometers And Advanced **Optical Systems**

Microwave/Submm/Far-IR

IR/Visible

In-situ Science and Instruments and MDL

Instrument Flight Software

Adv. Concepts **Technologies**

Mission Systems & Ops. 39

MSN System Ena and Planning

Mission Design

MOS and GDS

Design, Implementation and Operations

Sys Autonomy and Control

Science Data **Systems**

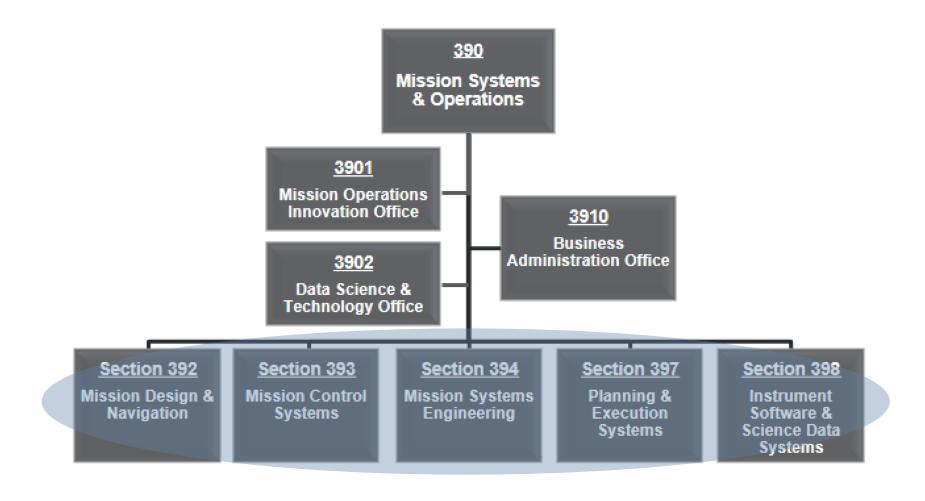
Adv. Concepts and **Technologies**

Onboard Instrument Operations S/W

Onboard Science Data Analysis S/W

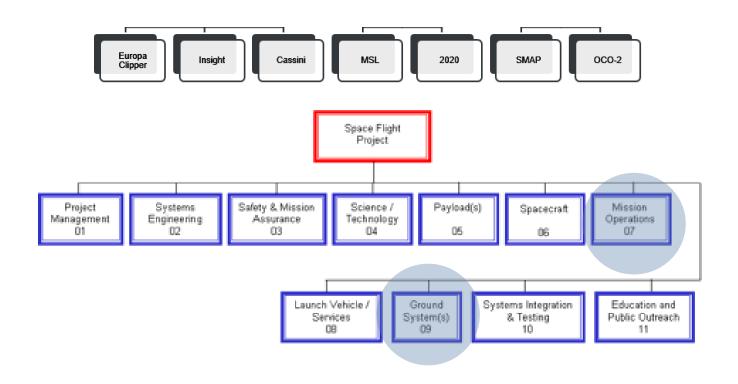
Data Science

Division 39 Structure – Mission Systems & Operations



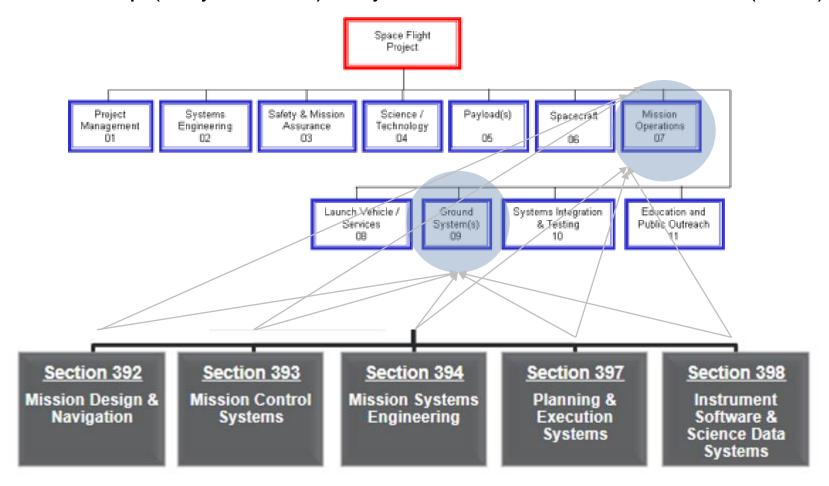
How Work Get Done

Relationship (Project / Line) Project Work Breakdown Structure (WBS)



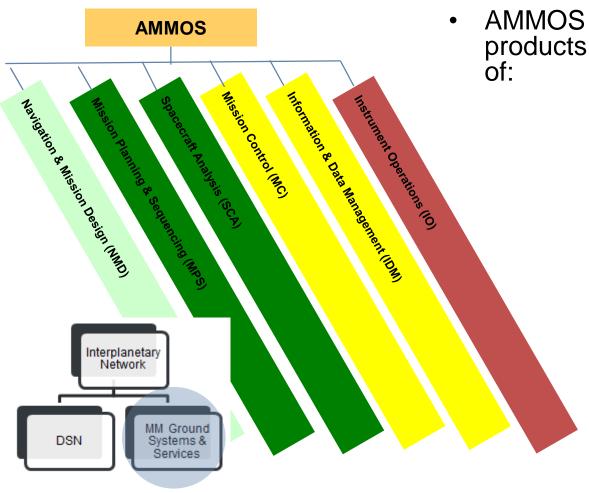
How Work Get Done

Relationship (Project / Line) Project Work Breakdown Structure (WBS)



Multi-Mission Ground Systems & Services

Advanced Multi-Mission Operations System

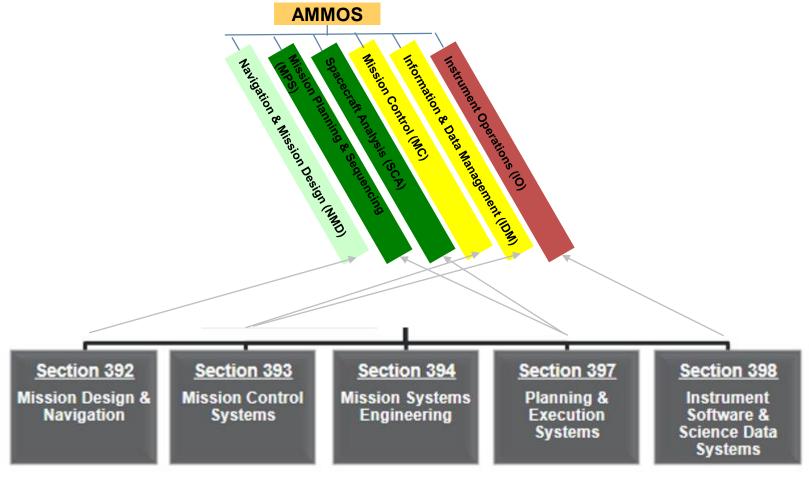


AMMOS provides missions with products and services in support

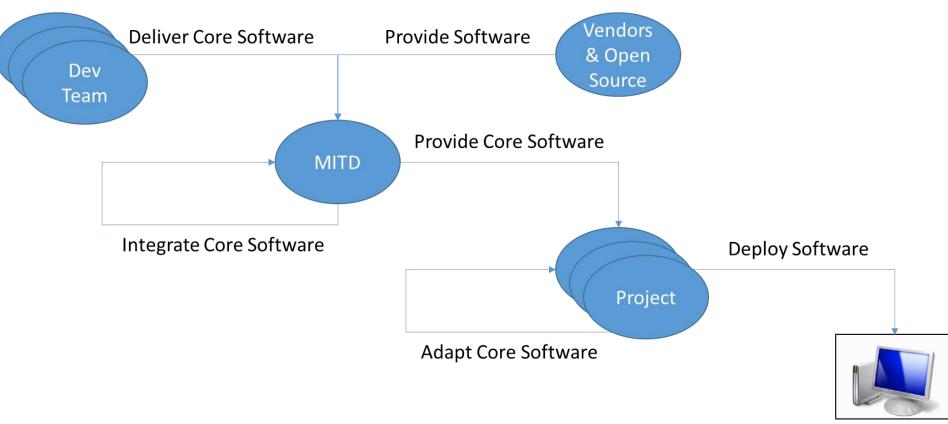
- Navigation and Mission Design
- Mission Planning and Sequencing
- Spacecraft Health and Performance Analysis
- Mission Control and Flight System Monitoring
 - Telemetry and Command
- Information & Data Management
- **Instrument Operations**
 - Instrument Data **Processing**

How Work Get Done

Relationship (Program / Line) – AMMOS Products & Service

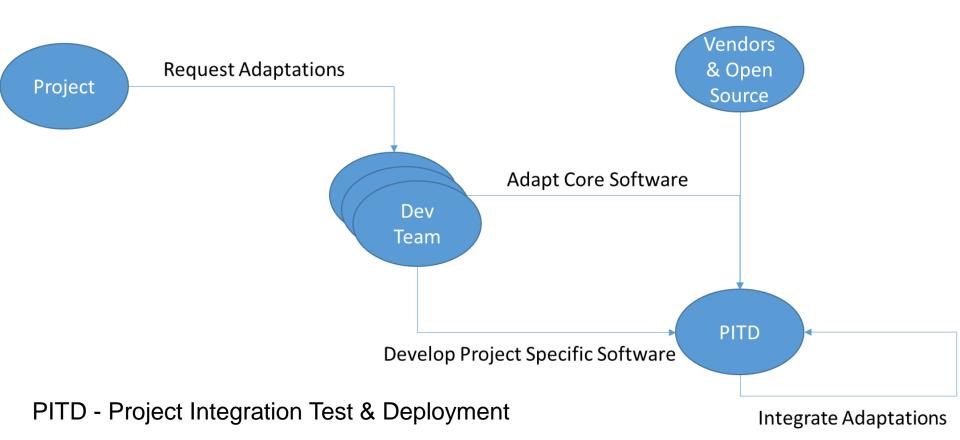


AMMOS / Project Delivery & Deployment Process

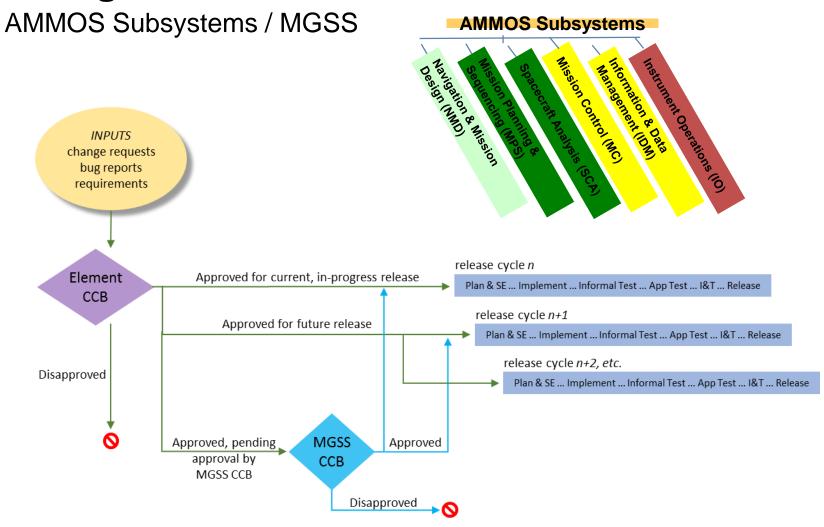


MITD - Multi-Mission Integration Test & Deployment

Project Adaptation Process



Change Control Board



Challenges – Related to Delivery

- MGSS updates AMMOS 3 times a year
 - Update patches (3rd party / Security) 9 times a year
 - Projects take updates based on project schedules
 - Project testing budget limited in operations phases
- Projects have independent schedules
 - Coordinating with multi-mission must be planned on 3 per year basis.
 - Depending on project lifecycle this may be too slow
 - Adaptation teams have to work with Core teams to ensure too many branches do not occur

Challenges – Related to funding

- MGSS updates AMMOS 3 times a year
 - Funded by NASA
 - New implementation funded on a 6 year plan
 - Seen as too slow for developing projects
 - Maintenance continuous
 - Corrective, Adaptive & Perfective
 - Delivers on 3 per year but must support all projects
- Projects have independent schedules
 - Project Size makes a difference
 - Large projects like to innovate Hard to capitalize and fold into Multi-mission
 - Large project innovation does not plan for maintenance

Questions?



jpl.nasa.gov